From A. Riga transmitter to experiments on the distant reception of telegraph signals

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This article discusses circumstances and events from the prehistory and early history of the radio, about the distant reception of signals drawn from available documentary materials.

Birth of a transmitter

After the great physicist G. Hertz (1857-1894) carried out the famous work in 1887-1888 on the observation of invisible electromagnetic oscillations (EMC) with a wavelength of 05 ... 0.6 m (600 ... 500 MHz) in Germany), many physicists in other European countries wanted to repeat his experiments and conduct their own studies of EMC at higher frequencies close to light.

Professor of Physics at the University of Bologna (Italy) A. Riga (1850-1921) suggested that G. Hertz could not fully show the identity of electric and light vibrations, since he did not have at his disposal the necessary physical devices (mirrors, lenses and prisms) , consistent in size with the lengths of the studied waves. Therefore, he set out on his own to study the phenomena of reflection, refraction, interference, and absorption of EMC at shorter waves using the smaller reflectors, absorbers, dielectrics, and polygonal figures transparent to EMC in his laboratory.

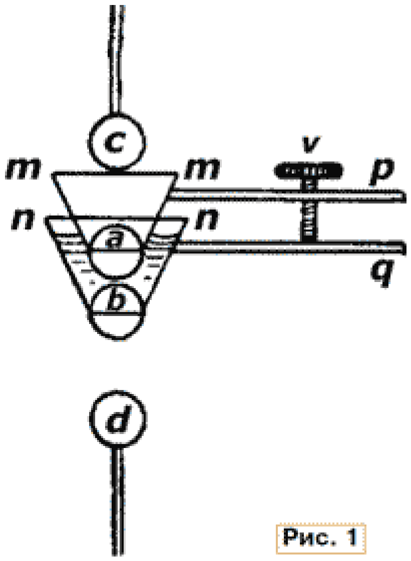

Рис. 1

To obtain EMC with shorter wavelengths than at the installations of a German physicist [1], A. Riga modified the Hertz vibrator, using brass hollow balls in it with a diameter of 4 cm to excite waves with a length of 20 cm (1500 MHz) and a diameter of 136 cm for 7.5 cm (4000 MHz) waves. From the ends of the emitter, he shifted the balls to the middle, where he doubled their number, placing them in series and removing the electrical connections between them, as shown in Fig. 1. He placed balls a and b in the glass funnels mm and nn, held by ebonite plates p and q. In the lower funnel nn filled with liquid paraffin, nn balls a and b, he arranged so that each of them was half in the insulating liquid in order to protect against carbonization and burning of surfaces during sparking. When the machine was turned on, sparks skipped like in the gap with ab oil,

A. Riga confirmed the studies and conclusions of Herz. The Russian version of one of his most remarkable articles, “Hertz's Experiments with Short Wavelength Oscillations” (1893), was published in [2, p. 387–397]. In total, he published about 250 scientific papers. In 1896 he became a member of the Imperial St. Petersburg Academy of Sciences.

Recall that the outstanding Russian physicist P. N. Lebedev (1866-1912) received even shorter waves with a length of 0.6 cm (50 GHz) in a generator constructed by the method of A. Riga. He observed their birefringence in crystals. He described the results of his work in the article “On the double refraction of rays of electric force” (1895), also presented in [2, p. 398-403].

The generator developed by A. Riga revealed an interesting and important feature. Doubling the number of resonating balls and bringing them closer to each other led to an increase in the EMC radiation power. Further study of the design made it possible to determine that the optimal diameter of the middle balls (a and b in Fig. 1), which allows obtaining the maximum power, is in the range from 20 to 40 cm. In addition, the replacement of all hollow balls of the generator with all-metal balls led to a doubling of the radiation power .

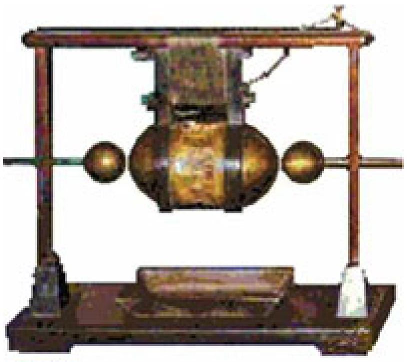

Рис. 2

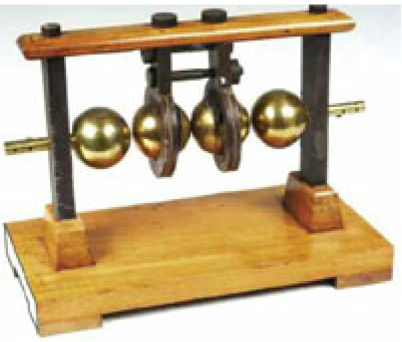

Рис. 3

The appearance of the modernized radiator A. Riga is shown in Fig. 2. Being placed in the focus of a parabolic copper reflector, A. Riga generator emitted EMC at distances ten times larger than the G. Hertz vibrator. Subsequently, to obtain even greater power, all the balls began to be made the same, this is shown in Fig. 3. The receiver for A. Riga was the same as for G. Hertz [1], which has the shape of a circle or a square frame, an open conductor resonator with brass balls in the gap, measured in millimeters.

After the publication of the works of the English physicist O. Lodge (1851-1940) - his speeches on June 1, 1894 with a lecture "Creation of Hertz" [2, p. 424-445] at the Royal Institute of London and on August 14, 1894 at Oxford University at a meeting of the British Association for the Advancement of Science, which had a wide response at European research centers, A. Riga already experimented with a coherer and an electric bell connected in series in the receiving circuit Hertz resonator. A. Riga corresponded with the Russian military engineer, physics teacher and pioneer in the study of wireless telegraphy A. S. Popov (1859-1906) [3]. The receiver circuit of A. S. Popov became known to him even before it was published in January 1896 in the article "A device for detecting and recording electric oscillations" [2, p. 449–458].

The phenomenon of G. Marconi

A. Riga maintained friendly relations with the family of the Italian Giuseppe Marconi, the owner of vineyards, the manufacturer of licensed whiskey "Jameson" (named after the name of his wife Annie Jameson, who came from an Irish family of producers and holders of the brand of the drink) and the parent Guglielmo Marconi (1874-1937) - the future active entrepreneur in the spread of wireless telegraphy. Despite the latter's lack of interest in systematic school education, A. Riga managed to captivate G. Marconi with physical experiments in wireless telegraphy. However, after graduating from high school and in a private preparatory course in physics, he was twice unable to pass entrance exams to Italian universities. However, he continued his studies with A. Riga and attended his laboratory work and lectures at the university.

In a dubbed autobiography "Wireless Telegraphy, 1895-1919" [4], G. Marconi reports that he began to conduct independent experiments on the transmission and reception of electric signals wirelessly in his father's estate in June 1895 until February 1896 inclusive. He used the attic at home as a laboratory room. In one of the experiments, he asked his older brother Alfonso to settle down over the hill. When the invisible transmitter was turned on, the EMC receiver rang, after which he fired from a gun, signaling the successful reception of the transmitted pulse. In the 21st century, this episode played out by actors was repeatedly shown on television in many countries (and Russia, too). However, the audience was not explained that at the end of the experiment, G. Marconi came to the erroneous conclusion that the EMC passes through the earth directly through the hill. In a year,

In [4], G. Marconi claims that, having secluded himself in a villa, for almost nine months of hard work he independently resolved all the basic issues of wireless telegraphy. In another autobiography, The History of My Life [6], he lists test assistants: the aforementioned 1 is already a brother, a relative from Ireland, and three civil engineers from the city of Bologna. Subsequently, none of them documented the successes of G. Marconi in the transfer of EMC.

In both autobiographies, it is not written about G. Marconi's appeals to technical journals or the Italian Patent Office during this period with proposals for the publication of the results of work, setting a priority for engineering solutions. At the very beginning of the second part in [4], the author does not agree with A. Riga's claims to borrow from that scheme and design of the spark transmitter. In his opinion, A. Riga used a modified G. Hertz generator to study the properties and features of EMC, while he himself initially found it more suitable for long-distance wireless telegraphy. In rather extensive in the number of pages memoirs, he is silent about the developer of the receiver.

To avoid being drafted into the army, in mid-February 1896, G. Marconi left Italy and moved to the UK. He brings equipment to London with which he worked on his father's estate. As a loyal citizen, G. Marconi first approached the Italian government with a proposal to establish a priority for his inventions in wireless telegraphy and their use. He filed the appeal through the Italian Embassy in London. But he did not receive a response from the government, after which he proceeded to patenting in the UK.

March 31, 1896 G. Marconi introduced the aristocrat "blue blood, the head and chief engineer of the telegraph department of Great Britain V. Pries (1834-1913). He liked an attractive and energetic young man. There is a rumor that V. Pryce, after familiarizing himself with the sketches and equipment elements, G. Marconi asked the technical service of the British Navy to conduct an examination and testing of this receiving and transmitting system (PPS). Appreciation was given to the technique.

To help G. Marconi for patent filing, W. Price attached a telegraph specialist, electrical engineer J. Kemp (1858-1933). Due to the superficial acquaintance with the scientific publications of physicists M. Faraday (1791-1867), G. Hertz, E. Branly (1844-1940), O. Lodge, A.S. Popov on electromagnetism G. Marconi unknown conditional images of elements of generators and receivers EMC in the technical documentation. J. Kemp was able to display elements on paper according to the rules adopted in the field of his occupation. Since patents related to telegraphy, he was entrusted with the preparation of their graphic part. As a result, in the first two patents of G. Marconi No. 12039 (1896, approved in 1897) and No. 12325 (1898, 1899), curious drawings were presented to the world, drawn in a manner that had no precedent before, and also after. In principle, the operation of devices according to these circuits cannot even be understood by modern specialists and amateur radio enthusiasts without involving the receiver circuit A.S. Popova.

On July 27, 1896, G. Marconi tested the teaching staff for the managers and employees of the London General Telegraph Office. The equipment was installed on the roofs of buildings, spaced apart at a distance of about 400 m. Reception of pulses was indicated by an electric bell.

During the next test of the teaching staff through the English Bristol Canal in May 1897, it was found that EMCs spread over the water surface over longer distances than on the earth’s surface, at the same receiver sensitivity and transmitter power. This observation served as the basis for another erroneous conclusion by G. Marconi that the water surface serves as a conductor of high-frequency EMC. He was even more established in such an error when he managed to establish communication across the English Channel (51 km) in March 1899.

Transatlantic non fortuna

At the end of the nineteenth century, physicists could not explain the trans-horizontal distribution of EMC, in contrast to light waves that go into the distance only in a straight line. G. Marconi believed that he was on the verge of one of the greatest discoveries in physics and, in order to finally establish himself in his judgments, he decided to arrange a demonstration show with the transmission of a semantic signal from Great Britain to the other side of the Atlantic Ocean. To implement the plan (one-way communication) in English, a half-built powerful transmitter and high antennas.

On December 12, 1901, G. Marconi, together with his permanent assistant J. Kemp, arrived at the highest point of Signal Hill, located near St. John's, the capital of Fr. Newfoundland (Canada), located 3,500 km from Halfday. Despite the scientific and technical significance of the planned event, no one was notified about this in advance and was not invited to communication sessions. The mystery of the planned test program is still not open. It is known that as the first test it was decided to test the “span” of the letter S by the ocean - three points (radio pulses) using the S. Morse code (1791-1872).

According to G. Marconi in [4], the first arrival of points in America as if took place on the same day at 12.30 local time. He took them “by ear”. For listening, I chose the assembled according to the scheme A.S. The next-generation Popov receiver [3] (without a coherer, with access to a single telephone) is the most sensitive of his available, but not equipped with a ribbon printing mechanism. J. Kemp was allowed to listen to the “point” signals in the same headphone. The next “set of points” arrived at 13.30, and after 14.20 it was possible to catch the signals of the letter S 25 times in a row (that is, as if there was a confident reception of signals). The next day, the impulses were heard again, but with less constancy. On December 14, it was not possible to work, because a strong wind blew an inflatable balloon, lifting the antenna wire into the air.

However, on December 15, a letter from the Anglo-American Telegraph Company (MTK) was in the hands of G. Marconi. In a letter, the organization's legal adviser said that the company had exclusive rights to transatlantic telegraph communications and to create communication systems with the English colonies, which also extended to Fr. Newfoundland. It was pointed out that the offender could be prosecuted if the work continued.

On the same day, G. Marconi made a statement to the press about his success in the first transmission of a semantic signal from Europe to America. Newspaper articles about the imminent possibility of wireless and cheaper communications between countries of far-distant continents excited the United States and Canada, caused panic on the stock exchange, and a drop in cable telegraph companies. None of the curious engineers and journalists were able to listen to the signals transmitted over the "air bridge" from England. Mr. Marconi did not agree to ignore the AATC ban. G. Marconi could not present doubters with materials (for example, a telegraph tape) confirming a unique event, as well as point to the independent experts present at the meeting. Recall that from biblical times it is known that any cases are not considered factual in the absence of documents or evidence,

A modern engineering study of the circumstances of a heroic attempt to transmit a modulated RF signal through the Atlantic Ocean in 1901 shows that it was not received on the opposite shore [8, 9].

We also note that in the middle of the day and on that medium wave (366 m) [8], on which G. Marconi heard the signals of the letter S, in Canada and now you will not hear English broadcasting stations on modern radios.

Thanks to resourcefulness, what happened G. Marconi was able to well advertise himself. With all this, the event would be unfair to call a scam. From the position of the present time it is more correct to call it an adventure. Mr. Marconi was seriously preparing for a transatlantic operation. He built in Poldew a powerful generator and antenna of a new configuration. However, he showed excessive arrogance in the absence of knowledge of the laws of physics on the atmospheric distribution of EMCs, and made a mistake in calculating the necessary emitter power for this case. The undertaken work on the transmission of signals over the ocean and the earth served as a visual agitation in favor of an ascending miraculous technology, quickly established, more convenient to use, capable of delivering news to where cable cannot reach, less expensive.

Held shares

Failure sobered G. Marconi, and he set about conducting what he should do right away — listening to the received EMC signals as he slowly moved across the sea from the transmitter to Halfday. In February 1902, on the ship "Philadelphia" he sailed towards the American coast. During the communication sessions, he managed to make a modest discovery: to understand that in the evening and at night EMCs spread over longer distances than in the daytime. He could not offer an explanation for this. At midnight on February 25, moving away from the EMC source to a distance of 2495 km, G. Marconi last time received signals of the same letter 8. He registered their uncertain flow at a distance of 3378 km (not confirmed by eyewitnesses). It was not possible to catch anything - it was not possible to be near the coast of the USA and Canada.

In June 1902, G. Marconi received permission to install receiving equipment on the military cruiser "Carlo Alberto" cruising around Europe on the occasion of the coronation of the King of Italy. He planned to receive signals from the modernized transmission center in Halfday. Confident receipt of telegraphic shipments turned out everywhere where the ship visited in June-August, at distances from 1600 to 2250 km, including the Strait of Gibraltar and the island of Corsica in the Mediterranean Sea, closed from the Midday Pyrenees Mountains. Long-range reception did not work when the cruiser was located from July 12 to July 21 in the Russian city of Kronstadt in the Baltic Sea. When visiting the ship, the Russian Emperor Nicholas II (1868-1918) with his retinue G. Marconi was able to demonstrate only the transfer of dispatches from one end of the cruiser to the other.

In November 1902, G. Marconi aboard the "Carlo Alberto" arrived at the port of Sydney, Canada, Nova Scotia (Nova Scotia) to continue experiments on long-distance communications. After a month of preparatory work, test transmissions of the letter S and other signs, G. Marconi decided that he was able to transmit telegrams consisting of many words from one coast (Canada) to the other coast (England). On December 16, 1902, a dispatch with best wishes to the peoples of Great Britain and Italy was sent to the London Times. In the following days, telegrams were sent to the kings of England and Italy and other statesmen. G. Marconi received the return messages with congratulations on achieving success in transatlantic air communications through an underwater telegraph cable. The

American engineer R. Fessenden (1866-1932) was first able to establish two-way wireless telegraph communication between the USA and Great Britain in January 1906 [10]. G. Marconi began exchanging telegrams on both sides of the “air bridge” across the Atlantic at a long wavelength of 3660 m (82 kHz) at the end of 1907.

Sky reflector

Attempts made by Europeans to establish ultra-long-distance communications through EMC drew the attention of the American electrical engineer A. Kenneli (1861-1939). He stated that when EMCs follow the surface of the earth and water, losses occur that are incompatible with their distant advancement. At the beginning of 1902, A. Kenneli made the assumption that in the upper atmosphere there may be a reflecting EMC layer, contributing to their distribution over long distances.

A little later, a similar conjecture was made by the English physicist-theoretician of wire telephony O. Heaviside (1850-1925). In June 1902, in an article "Theory of Electric Telegraphy" written for the 10th edition of the Encyclopedia Britannica, in a brief remark from several lines, O. Heaviside noted: “ *It is possible that there is a sufficiently conductive layer in the upper atmosphere. If this is so, then the waves will be, to say so, captured by this layer to a greater or lesser extent.*." [eleven]. The scientist led a secluded life and engaged in scientific work in solitude at home. I did not do practical work. Just like A. Kenneli, he did not make any attempts to verify the hypothesis. However, G. Marconi and other specialists in wireless telegraphy by practical experiments showed the presence of a celestial substance reflecting long medium and short waves and received the name "Kenneli-Heaviside layer", but also did not study its features.

In Europe, O. Heaviside was supported by the famous English physicist O. Lodge and a number of other famous scientists. Once again, V. Pries spoke out against the judgments of a theoretical scientist. O. Heaviside had long-standing reasons to dislike W. Price. In his opinion, he delayed the arrival of wire telephony in the UK for about 20 years. A sharp and ill-founded attack forced O. Heaviside to once again call V. Pris a false scientist in the next publication [Chapter 11, 13]. Later, G. Marconi began to speak out unkindly about V. Pris. He recalled to him exorbitant material payments for joint experimental work carried out in the 1890s on the premises of his telegraph department and at the training grounds, as well as skeptical remarks addressed to him in public speaking [4]. In 1924, the English physicist E. Appleton (1892–1965) embarked on the scientific research of the reflectivity of the “Kenneli – Heaviside layer”. Together with the American (USA) physicist S. Barnett (1873-1956), he experimentally sensed the atmosphere with radio-pulse signals and revealed several ionized reflective layers. He explained that their ionization occurs due to the constant bombardment of air molecules in the upper atmosphere by particles flying from the Sun from space. he devoted his subsequent life to studying the problems and issues of the propagation of radio waves in the atmosphere. For carrying out large-scale research work, he was awarded the Nobel Prize in 1947 [12]. Recall that the human voice through radiotelephony across the Atlantic Ocean was transmitted for the first time in 1915 [13]. Appleton (1892-1965). Together with the American (USA) physicist S. Barnett (1873-1956), he experimentally sensed the atmosphere with radio-pulse signals and revealed several ionized reflective layers. He explained that their ionization occurs due to the constant bombardment of air molecules in the upper atmosphere by particles flying from the Sun from space. he devoted his subsequent life to studying the problems and issues of the propagation of radio waves in the atmosphere. For carrying out large-scale research work, he was awarded the Nobel Prize in 1947 [12]. Recall that the human voice through radiotelephony across the Atlantic Ocean was transmitted for the first time in 1915 [13]. Appleton (1892-1965). Together with the American (USA) physicist S. Barnett (1873-1956), he experimentally sensed the atmosphere with radio-pulse signals and revealed several ionized reflective layers. He explained that their ionization occurs due to the constant bombardment of air molecules in the upper atmosphere by particles flying from the Sun from space. he devoted his subsequent life to studying the problems and issues of the propagation of radio waves in the atmosphere. For carrying out large-scale research work, he was awarded the Nobel Prize in 1947 [12]. Recall that the human voice through radiotelephony across the Atlantic Ocean was transmitted for the first time in 1915 [13]. Barnett (1873-1956), he experimentally sensed the atmosphere with radio-pulse signals and revealed several ionized reflective layers. He explained that their ionization occurs due to the constant bombardment of air molecules in the upper atmosphere by particles flying from the Sun from space. he devoted his subsequent life to studying the problems and issues of the propagation of radio waves in the atmosphere. For carrying out large-scale research work, he was awarded the Nobel Prize in 1947 [12]. Recall that the human voice through radiotelephony across the Atlantic Ocean was transmitted for the first time in 1915 [13]. Barnett (1873-1956), he experimentally sensed the atmosphere with radio-pulse signals and revealed several ionized reflective layers. He explained that their ionization occurs due to the constant bombardment of air molecules in the upper atmosphere by particles flying from the Sun from space. he devoted his subsequent life to studying the problems and issues of the propagation of radio waves in the atmosphere. For carrying out large-scale research work, he was awarded the Nobel Prize in 1947 [12]. Recall that the human voice through radiotelephony across the Atlantic Ocean was transmitted for the first time in 1915 [13]. he devoted his subsequent life to studying the problems and issues of the propagation of radio waves in the atmosphere. For carrying out large-scale research work, he was awarded the Nobel Prize in 1947 [12]. Recall that the human voice through radiotelephony across the Atlantic Ocean was transmitted for the first time in 1915 [13]. he devoted his subsequent life to studying the problems and issues of the propagation of radio waves in the atmosphere. For carrying out large-scale research work, he was awarded the Nobel Prize in 1947 [12]. Recall that the human voice through radiotelephony across the Atlantic Ocean was transmitted for the first time in 1915 [13].

Note that in Russia, academicians L.I. studied the propagation of radio waves over the earth's surface and accurate measurements of the speed of their movement in the 1930s. Mandelstam (1879-1944) and N.D. Papaleksi (1880-1947).

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